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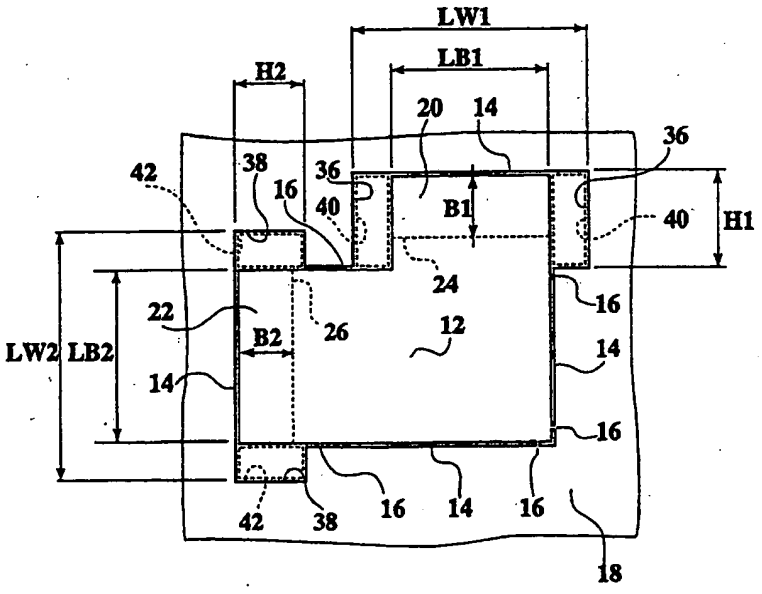

(57) Abstract

A method and apparatus for the production of bent sheet metal pieces (12) is disclosed. In the method or apparatus, a cut (14) is made in a sheet of sheet metal (10) that defines the perimeter of piece (12) to be obtained. The cut (14) is interrupted at preselected points to form a series of microjoints (16) that keep the plan development of the piece (12) united with the stiffening frame (18) constituted by the remaining part of the metal sheet (10). At least one window (36, 38) is formed in the stiffening frame (18) in order to allow a pair of bending tools having a length greater than the length of the bend to form a bend (20, 22) on the piece (12) without interfering the stiffening frame (18) while the bend is being formed.

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DESCRIPTION

TITLE OF THE INVENTION

METHOD AND APPARATUS FOR THE PRODUCTION OF BENT SHEET METAL PIECES

Technical Field

The present invention generally relates to the processing of pieces of sheet metal (hereinafter sheet metal pieces) by bending operations. The present invention is more particularly related to a bending operation of the type in which the developments in a plan (hereinafter plan developments) of the pieces to be bent are defined in the plane of a sheet metal by cutting the sheet along a cutting run interrupted at preselected points to form a series of microjoints that will keep the plan development of the piece united with the remainder of the sheet. The bending of the pieces is carried out while the plan development of each piece remains joined to the remaining part of the metal sheet by means of the microjoints.

Background art

Methods of the type just described are advantageous, above all, when the pieces to be bent are of relatively small size. In that case, in fact, the plan developments of several such pieces can be defined on a single metal sheet. The part of the sheet that surrounds the plan developments of the various pieces normally constitutes a waste but, before this material is thrown away, it is used as a kind of stiffener or stiffening frame that sustains the individual pieces during the bending operation. On completion of the bending operations, the bent pieces are separated from the stiffening frame by either cutting or breaking the microjoints.

A method for cutting and bending pieces of sheet metal in accordance with the steps just described in broad outline can be realized, for example, in an integrated cutting and bending system of the type described in Italian patent application No. TO95A00059 filed by the present applicant. In a system of this type the bending can be carried out in automatic fashion by means of the particular type of press described in EP-A-0725692. For the bending operations to be correctly performed in a system of this type, it is essential to employ bending tools (i.e. punch and die) of a length

to employ bending tools (i.e. punch and die) of a length substantially the same as the length of the bend to be made. This implies the need not only of keeping a considerable stock of tools with a large number of spares, but also of frequently changing the tools used with the bending press whenever the bends to be made are of different lengths.

Disclosure of Invention

The present invention provides method and apparatus of the type described hereinabove that would make it possible to overcome these drawbacks.

According to the present invention, this scope can be attained by means of a procedure having the characteristics that form the subject of the principal claims hereunder.

The innovative concept underlying the present invention includes the fact that in the cutting phase at least one window is cut in the stiffener material adjacent to a bend to be formed in the piece. The dimensions of the window, or windows, are selected in such a way as to make it possible for the bend to be made with two tools (i.e. punch and die), each having a length greater than the length of the bend to be made; i.e. the tools interferes with the stiffener frame without the window, or windows.

This makes it possible to keep a smaller stock of press tools and to cut down the frequency of the tool-changing operations, with obvious advantages as far as idling times during the processing operations are concerned.

Further characteristics and advantages of the present invention will become clear in the course of the detailed description which follows, given solely by way of non limiting example, with reference to the attached drawings.

Brief Description of Drawings

Figure 1 shows a sheet metal prepared for carrying out the bending operations in the bending press and the selection of bending tools to be used with this machine.

Figure 2 is a schematic view at a larger scale of the part indicated by the arrow II in Figure 1.

Figure 3 is a schematic view of the metal sheet of Figure 1 during the bending operation.

Figure 4 is a schematic perspective view at a larger scale of the part indicated by the arrow IV in Figure 3.

Figures 5, 6, and 7 show a section along the line V of Figure 4 during the various phases of the bending operation.

Figure 8 is a block diagram of an apparatus in accordance with the present invention.

Figure 9 is a logic flow diagram showing operation of the apparatus of Figure 8.

Best Mode for Carrying Out the Invention

The drawings attached hereto provide schematic illustrations of some phases of a method for the production of bent sheet metal pieces. During the course of the method the metal sheet 10 is first subjected to a preliminary cutting operation. The cutting operation is for defining on the sheet 10 the plan development of one or more pieces 12 to be obtained. The cutting operation may be carried out, for example, with a laser machine. Figure 1 shows, for example, a case in which the plan developments of six identical pieces 12 have been obtained on the metal sheet 10. However, the method according to the invention can be employed no matter what the number or the shape of the pieces is obtained.

Turning now to Figure 2, the reference number 14 indicates the cutting run or line along the outer perimeter of the plan development of one such piece 12. The cutting run 14 is interrupted at preselected points 16 in such a way as to form a series of microjoints that connect the plan development of the piece 12 to the remaining part 18 of the metal sheet 10. The remaining part 18 constitutes a stiffening frame used to support the pieces during the bending operation. As will be explained in greater detail below, the bending operations are carried out while the plan developments of the pieces 12 are still connected to the stiffening frame 18 by means of the microjoints. On completion of the bending operations, the finished pieces are separated from the stiffening frame by breaking or removing the microjoints 16. The breaking or removing the microjoints 16 may be performed by means of any known system and, preferably, the device and procedure described in Italian patent application No. TO94A000505 in the name of the present applicant.

In the example illustrated by Figure 2, we shall suppose that two flaps or flanges 20, 22 have to be obtained by means of bending operation along the lines 24 and 26. The lengths of the two bends are shown in the figure as respectively L_{B1} and L_{B2}.

The remainder of Figure 1, schematically indicated by the number 28, shows the set of tools of a bending press to be used for bending the pieces. Purely by way of example, the stock of tools of the bending press not shown in the figure has been schematically represented by three punch-and-die pairs 30, 32, 34 of different lengths, these lengths being indicated by, respectively, L_1, L_2 and L_3. The bending press to be used for carrying out the bending operations can be, for example, of the type described and illustrated in Italian patent application No. TO93A000818.

In the case in which the available tool stock of the bending press includes a tool pair of the same length as the bend to be made, the bend may be made in the manner described in detail in Italian patent applications Nos. TO93A000818 and TO95A0005669. The present invention, on the other hand, is applied whenever the length of the bend to be made differs from the length of any available tool pair. In that case the procedure is as follows. As a preliminary, however, it should here be specified that both the cutting and the bending are carried out under the control of a programmable electronic unit, which makes it possible to transfer information from the cutting machine to the bending machine and vice versa. Appropriate information regarding the shape and size of the pieces to be obtained is stored in the electronic control unit, so that the control unit can readily obtain the necessary information about the length of the bend that is to be made. If none of the available tool pairs is of the same length as the bend to be made, the control unit selects a tool pair having a length L greater than the length of the bend to be made. By way of example, let us suppose that the bend L_{B1} is of a length intermediate between the lengths of the tool pairs L_1 and L_2 and that the length of the bend L_{B2} is of a length intermediate between the lengths of the tool pairs L_2 and L_3. In this situation the machine could select the tool pair 32 far making the bend 24 and the tool pair 34 for making the bend 26; alternatively, however, it could select the tool pair 34 of the length L_3 for making both the bend 24 and the bend 26. The selected tools can be fitted to the bending press by means of, for example, an automatic tool-changing system of the type described in detail in Italian patent application No. TO93A000818.

The information regarding the length of the tool pair selected for carrying out the bending operation is transferred to the cutting machine, which may be programmed in such a manner as to enable it to autonomously modify the cutting program formulated in the manner subsequently to be described. Alternatively, the choice of tools and the

consequent modification of the cutting run can be carried out manually and then set in the control unit of the system that supervises the cutting and bending operations.

In any case, the cutting run 14 is modified with respect to the theoretical trace that coincides with the perimeter of the plan development of the piece 12. These modifications consist of cutting one or more windows on the bending lines 24, 26. In the example shown in Figure 2, a window pair 36, 38 has been obtained on each of the bending lines 24, 26, the windows in each case being arranged at the opposite ends of the bend (i.e. flap or flange) 20, 22 to be obtained. The shapes and the sizes of these windows are determined in such a manner that there will be no interference between the tools and the stiffening frame 18 surrounding the plan development of the pieces 12 when the bends 24, 26 are made with the selected tool pairs. Firstly, the dimension of the windows 36, 38 in the direction of their respective bending lines 24, 26 must be such that the sum L_{w1}, L_{w2} of the length L_{B1}, L_{B2} of the bending line 24, 26 and the lengths of the windows 36, 38 along the bending lines 24, 26 is always equal to or greater than the length of the selected tool pair. When the tool pair 34 has been selected for making both the bends 24, 26 for example, the distances L_{W1} and L_{W2} may be substantially equal to each other and will be slightly longer than the length L_3 of the selected tool pair 34. In the direction at right angles to their respective bending lines 24, 26, moreover, the windows 36, 38 must have dimensions H_1 and H_2 equal to or greater than the widths B_1 and B_2 of the respective flaps 20, 22. The pieces of waste material that have to be removed by cutting in order to obtain the windows 36, 38 are shown by means of broken lines in Figure 2, where they have been attributed the reference number 40 in the first case and 42 in the second case.

The bending phase is schematically illustrated in Figures 3 and 7. As can be seen from Figure 3, the stiffening frame 18 is held in a vertical position by means of a pair of clamping elements 44. The selected tool pair, which may be the pair 34 for example, successively creates the bends of the various pieces while these are still connected to the stiffening frame 18 by means of the microjoints 16. Whenever it performs an individual bending operation, the punch-and-die pair 34 carries out an approach movement in the direction indicated by the arrows 46 in Figures 3 and 4. At the same time, the tool pair 34 performs a rotation in the direction indicated by the arrow 48 so as to rotate through an angle equal to half the bending angle to be made upon the flap 20 and so as to accompany the movement of the said flap see Figures 5, 6 and 7 in particular.

As can be seen in Figures 4 and 7, the windows 36, arranged and dimensioned as described above, make it possible for the bend to be obtained with a tool pair having a length greater than the length of the bend while avoiding any interference between the tools 34 and the stiffening frame 18.

After having performed all the required bending operations, while possibly replacing the tool pair 34 with another when ends of a different length have to be made, the entire metal sheet is transferred to another workstation, where the bent pieces 12 are separated from the stiffening frame 18 by means of cutting or breakage of the microjoints.

Figure 8 is a block diagram of an apparatus for manufacturing bent sheet metal pieces in accordance with the method described above. This apparatus includes a cutting apparatus 100 for cutting a sheet metal 10 along a suitable line 14 to form sheet metal pieces 12 in the sheet metal 10, and a bending apparatus 102 for performing a bending operation on each of the sheet metal pieces 12 along suitable bending lines 24, 26. The cutting apparatus 100 includes a cutting machine 104, such as a laser cutting machine, for performing the cutting operation on the sheet metal 12 and a first control device 106 for controlling the operation of the cutting machine 104. Under the control of the first control device 106, the cutting machine 104 cuts the sheet metal 12 along the cutting line 14 to form the sheet metal pieces 12 in the sheet metal 10 and forms the windows 36, 38 in the stiffening frame 18. The bending apparatus 102 includes a bending machine 108, such as a press brake, and a third control device 110 for controlling the operation of the bending machine 108.

The apparatus of Figure 8 further includes a second control device 112 for providing various date to the first and third control devices 106 and 110. The second control device 112 includes a bending tool selecting means 114 for selecting a bending tool to be used in the bending machine 108 and a window dimension calculation means 116 for calculating the dimensions of the window 36, 38 on the basis of the dimension of the bending tool selected by the bending tool selecting means 114. The second control device 112 further includes a bending tool data memory 118 for storing the dimensions (such as the lengths) of the available bending tools 34, and a sheet metal piece data memory 120 for storing data, such as shapes and dimensions, of the sheet metal pieces 12.

Figure 9 is a logic flow diagram showing operation of the apparatus of Figure 8.

At step S1, the length LB1, LB2 of a bending line 24, 26 is detected by the bending tool detecting means 114 on the basis of the dimensions of the sheet-metal piece 12 stored in the sheet-metal piece data memory 120.

At step S3, the lengths L1, L2, L3 of bending tools 30, 32, 34 available for the bending operation are detected by the bending tool detecting means 114 on the basis of the data stored in the bending tool data memory 118.

At step S5, each length L1, L2, L3 of the available bending tool is compared with the length of the bending line LB1, LB2 by the bending tool selecting means 114.

If a bending tool whose length L1, L2, L3 is the same as the length LB1, LB2 of the bending line 24, 26 is located at step S5, that bending tool is selected at step S7 by the bending tool selecting means 114 as the bending tool to be used in the bending machine 108.

If no bending tool whose length L1, L2, L3 is the same as the length LB1, LB2 of the bending line 24, 26 is located at step S5, then a bending tool whose length L1, L2, L3 is greater than the length LB1, LB2 of the bending line is selected at step S9 by the bending tool selecting means 114.

At step S11, the dimensions LW1, LW2, H1, H2 of the windows 36, 38 are calculated by the window dimension calculating means 116 on the basis of length L1, L2, L3 of the selected bending tool and the widths B1, B2 of flanges 20, 22 to be formed.

At step S13, the cutting operation is carried out by the cutting machine 104 on the basis of data provided by the window dimension calculating means 116 and by the sheet metal piece data memory 118. As a result, the sheet metal is cut along the lines 14 so that the sheet metal pieces 12 are connected to the stiffening frame 18 by the microjoints 16, and windows 36, 38 are formed in the stiffening frame 18, as shown in Figure 2.

At step S15, bending operation is performed on each of the sheet metal pieces 12 along the bending lines 22, 24 by the selected bending tool 34 selected by the bending tool selecting means 113 and mounted on the bending machine 108.

CLAIMS

1. A method of cutting a sheet-metal (10) along a suitable line (14) to form sheet-metal pieces (12) in a sheet-metal (10) so that each of sheet-metal piece (12) is partially joined to a stiffening frame (18) by a microjoint (16), the method comprising the step of:

forming a window (36, 38) in the stiffening frame (18) for allowing a bending tool (34) to perform a bending operation on the sheet-metal piece (12) without interfering with the stiffening frame (18), the window (36, 38) being formed in an area of the stiffening frame (18) adjacent to the sheet-metal piece (12) and located on an extension line of the bending line (24, 26) of the sheet-metal piece (12).

2. The method of claim 1, wherein the microjoint (16) is formed only between an area of the sheet-metal piece (12) corresponding to a single face of a bent sheet-metal piece and an area of the stiffening frame facing that area of the sheet-metal piece (12).

3. A sheet-metal (10) formed with sheet-metal pieces (12) each of which is partially joined to a stiffening frame (18) by a microjoint (16), wherein

a window (36, 38) is formed in the stiffening frame (18), for allowing a bending tool (34) to perform a bending operation on the sheet-metal piece (12) without interfering with the stiffening frame (18), the window (36, 38) being formed in an area of the stiffening frame (18) adjacent to the sheet-metal piece (12) and located on an extension line of the bending line (24, 26) of the sheet-metal piece (12).

4. A method of manufacturing metal sheet pieces (12) each formed with a bent flange (20, 22), comprising the steps of:

(a) cutting a sheet-metal (10) along a suitable line (14) to form sheet-metal pieces (12) in a sheet-metal (10) so that each of sheet-metal piece (12) is partially joined to a stiffening frame (18) by a microjoint (16);

(b) performing a bending operation on each sheet-metal piece (12) along a suitable bending line (24, 26); and

(c) separating a bent sheet-metal piece from the stiffening frame (18)

wherein a window (36, 38) is formed, before performance of the bending operation, in the stiffening frame (18) for allowing a bending tool (34) to perform the bending operation on the sheet-metal piece (12) without interfering with the stiffening frame (18), the window (36, 38) being formed in an area of the stiffening frame (18) adjacent to the sheet-metal piece (12) and located on an extension line of the bending line (24, 26) of the sheet-metal piece (12).

5. The method of claim 4, wherein the window (36, 38) is formed during the step (a).

6. The method of claim 5, wherein the length of the bending tool (34) is greater than the length of the bending line (24, 26).

7. The method of claim 6, wherein the window has a rectangular shape, and a sum of the length of the bending line (24, 26) and a length of the window (36, 38) in the direction of the bending line (24, 26) is greater than the length of the bending tool (34).

8. The method of claim 6, wherein windows (36, 38) are formed in areas on both sides of the sheet-metal piece (12) along the bending line (24, 26).

9. A method of producing bent sheet metal pieces, comprising the steps of:

making a cut (14) in a sheet metal which follows a path defining the perimeter of at least one piece (12) to be obtained, the cut (14) being interrupted at preselected points to form a series of microjoints (16) that keep said piece (12) united with the stiffening frame (18) constituted by the remainder of the metal sheet;

selecting a pair of bending tools from a plurality of such tool pairs (30, 32, 34) available in the tool stock (28) of a bending press;

using the bending press to make at least one bend on the piece (12) with the selected bending tools while the piece (12) is still united with the stiffening frame (18) by said microjoints (16), so as to form at least one flap (20, 22) which comes out from the plane of the metal sheet; and

separating the piece (12) from the stiffening frame by cutting or breaking the said microjoints (16);

wherein the method further comprises a step in which the length of at least one bend (24, 26) to be made is compared with the lengths (L_1, L_2, L_3) of the available tool pairs and, whenever the length (L_{B1}, L_{B2}) of the bend does not coincide with the length of one of the available tool pairs, a tool pair of a length greater than the length of the bend to be made is selected and wherein in the cutting step, at least one window (36, 38) is obtained in the stiffening frame (18) adjacent to the flap (20, 22) to be formed, said window (36, 38) having dimensions such that the selected tool is allowed to make the bend on the piece (12) without interfering with the stiffening frame (18).

10. The method in accordance with Claim 9, wherein said at least one window (36, 38) has a first dimension along the bending line (24, 26) such as to form a free space within the stiffening frame (18) having a length equal to or greater than the length of the selected tool pair.

11. The method in accordance with Claim 9, wherein said window (36, 38) has a second dimension in the direction at right angles to the bending line (24, 26), the second dimension being equal to or greater than the width (B_1, B_2) of the flap to be formed.

12. The method in accordance with Claim 9, further comprising a step of cutting a pair of windows (36, 38) situated on opposite sides of each flap (20, 22) to be formed.

13. The method in accordance with Claim 12, wherein each of said windows is quadrangular in shape.

14. An apparatus for manufacturing from a sheet-metal (10) a sheet-metal piece (12) formed with a bent flange (20, 22), comprising:

a cutting apparatus (100) for cutting the sheet-metal (10) along a suitable line (14) to form sheet-metal pieces (12) in a sheet-metal (10) so that each of sheet-metal piece (12) is partially joined to a stiffening frame (18) by a microjoint (16); and

a bending apparatus (102) for performing a bending operation on each sheet-metal piece (12) along a suitable bending line (24, 26), wherein

the cutting apparatus (100) is adapted to form in the stiffening frame (18) a window (36, 38) for allowing a bending tool (34) to perform the bending operation on the sheet-metal piece (12) without interfering with the stiffening frame (18), the window (36, 38) being formed in an area of the stiffening frame (18) adjacent to the sheet-metal piece (12) and located on an extension line of the bending line (24, 26) of the sheet-metal piece (12).

15. The apparatus of claim 14,wherein the cutting apparatus (100) comprising,

a cutting machine (104) for performing the cutting operation on the sheet-metal (12); and

a first control device (106) for controlling operation of the cutting machine (100) so that the cutting machine performs the cutting operation to form the window (36, 38) in the stiffening frame (18).

16. The apparatus of claim 15, wherein the window (36, 38) has a suitable shape in accordance with a type of a bending tool (34) to be used in the bending apparatus (102).

17. The apparatus of claim 16, wherein the window (36, 38) has a suitable shape in accordance with a shape of the bending tool (34) to be used in the bending apparatus (102).

18. The apparatus of claim 17, wherein the window (36, 38) has a suitable dimension in accordance with a length of the bending tool (34) to be used in the bending apparatus (102).

19. The apparatus of claim 18, wherein the window (36, 38) is formed when the length of the bending tool (34) in the direction of the bending line is greater than the length of the bending line (24, 26).

20. The apparatus of claim 14 further comprising a second control device (112) that includes a bending tool selecting means (114) for selecting a bending tool to be used in the bending apparatus (102) and a window dimension calculating means (116) for calculating

a dimension of the window on the basis of the dimension of the bending tool selected by the bending tool selecting means (114).

21. The apparatus of claim 20, wherein the bending tool selecting means (114) compares a length of one of a plurality of available bending tools (34) with a length of the bending line (24, 26) and selects a bending tool (34) whose length is greater than that of the bending line (24, 26).

22. The apparatus of claim 20, wherein the second control device (112) includes a bending tool data memory (118) for storing lengths of the available bending tools (34).

23. The apparatus of claim 20, wherein the second control device (112) includes a sheet-metal piece data memory (120) for storing data of shapes and dimensions of the sheet-metal piece (12).

24. The apparatus of claim 14, wherein a sum of the length of the bending line (24, 26) and the width of the windows (36, 38) in the direction of the bending line (24, 26) is the same as or greater than the length of the bending tool, and a width of the window (36, 38) in the direction perpendicular to the direction of the bending line (24, 26) is greater than the length of the flange (20, 22) to be formed by the bending operation.

25. The apparatus of claim 14, wherein the cutting apparatus (100) includes a laser cutting machine (104).

26. The apparatus of claim 14, wherein the bending apparatus (102) includes a press brake (108).

27. A memory for storing a control program for controlling an operation of a cutting machine (104) through a computer, wherein the control program controls the cutting machine (104) through a computer so that the cutting machine (104) cuts the sheet-metal (10) along a suitable line to form sheet-metal pieces (12) in a sheet-metal (10) (14) such that each of sheet-metal piece (12) is partially joined to a stiffening frame (18) by a

microjoint (16), and so that the cutting machine (104) forms in the stiffening frame (18) a window (36, 38) for making it possible for a bending tool (34) to perform the bending operation on the sheet-metal piece (12) without interfering with the stiffening frame (18), the window (36, 38) being formed in an area of the stiffening frame (18) adjacent to the sheet-metal piece (12) and located on an extension line of the bending line (24, 26) of the sheet-metal piece (12).

28. The memory of claim 27, wherein a dimension of the window (36, 38) is determined in accordance with the dimension of the bending tool (34).

29. The memory of claim 27, wherein a sum of the length of the bending line (24, 26) and the width of the windows (36, 38) in the direction of the bending line (24, 26) is the same as or greater than the length of the bending tool, and a width of the window (36, 38) in the direction perpendicular to the direction of the bending line (24, 26) is greater than the length of the flange to be formed by the bending operation.

30. The method of claim 4, wherein the method further comprises the steps of:

detecting a length of the bending line on the basis of data relating to dimensions of the sheet-metal piece;

detecting lengths of bending tools available for the bending operation;

comparing the length of the bending line and each length of the available bending tool;

selecting a bending tool so that length of the bending tool is greater than the length of the bending line when no bending tool whose length is the same as the bending line is located;

calculating dimensions of the window (36, 38) on the basis of dimensions of the selected bending tool.

31. A memory of claim 27, wherein the program controls a computer so that computer performs the steps of:

detecting a length of the bending line on the basis of data relating to dimensions of the sheet-metal piece;

detecting lengths of bending tools available for the bending operation;

comparing the length of the bending line and each length of the available bending tool;

selecting a bending tool so that length of the bending tool is greater than the length of the bending line when no bending tool whose length is the same as the bending line is located;

calculating dimensions of the window (36, 38) on the basis of dimensions of the selected bending tool.

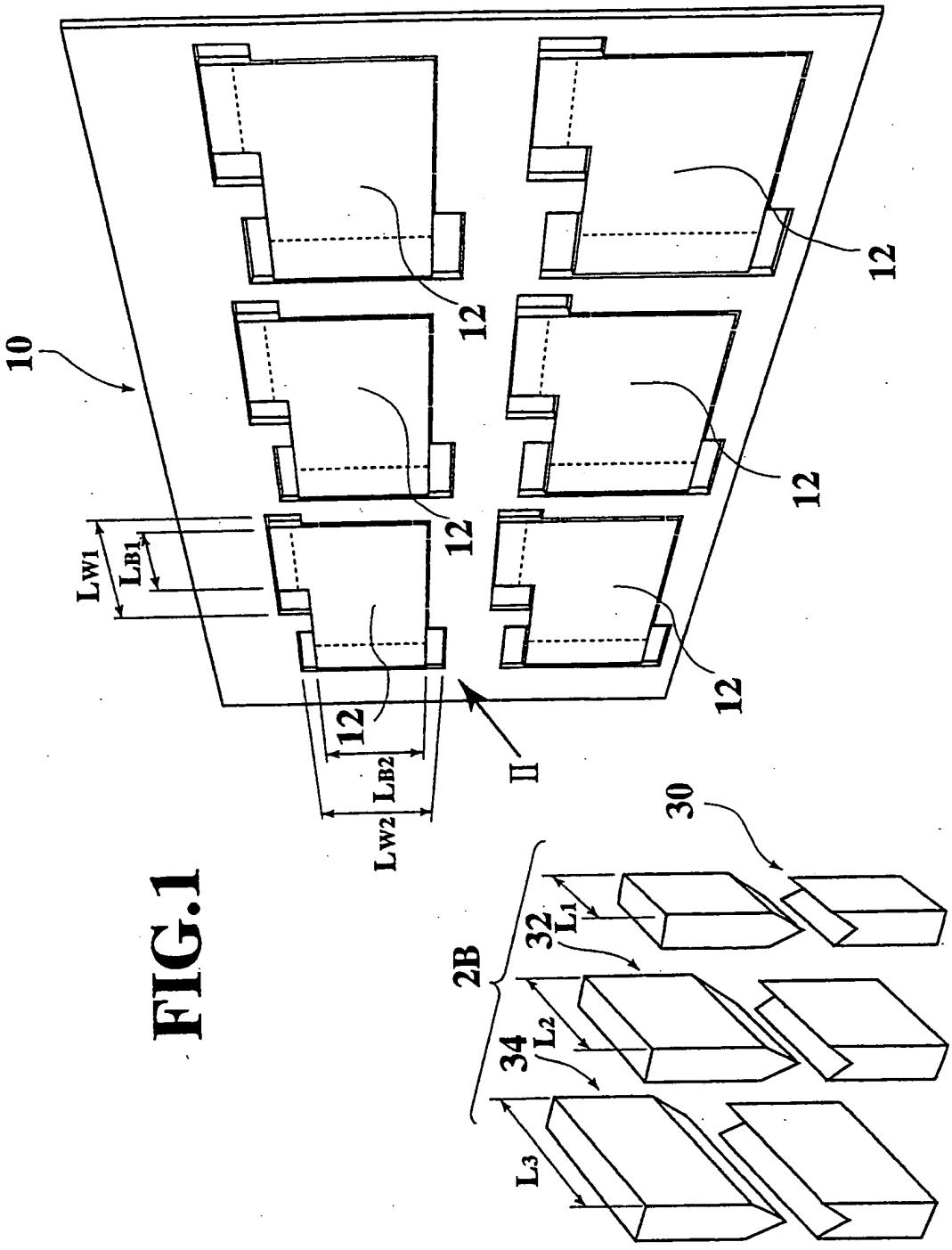


FIG.1

FIG.2

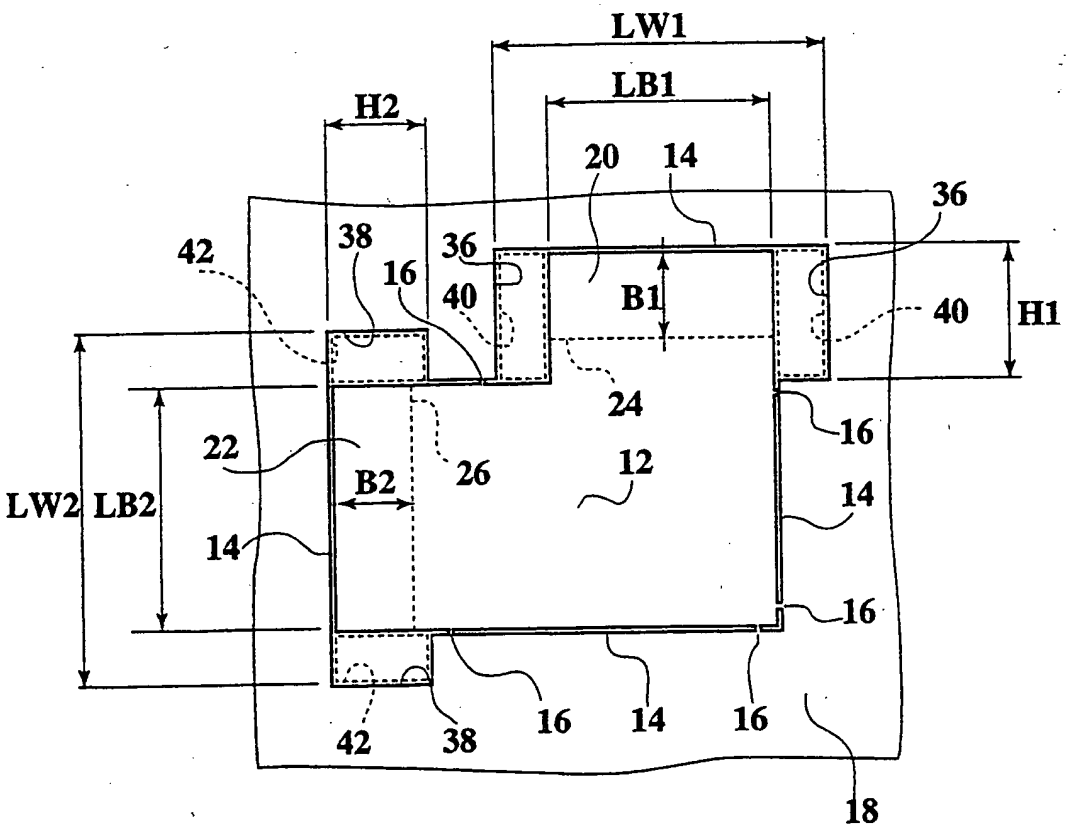

LW1
LB1
H2
20
14
36
38
36
42
16
40
B1
40
H1
24
16
22
26
12
B2
LW2
LB2
14
14
16
16
14
16
42
38
18

FIG.3

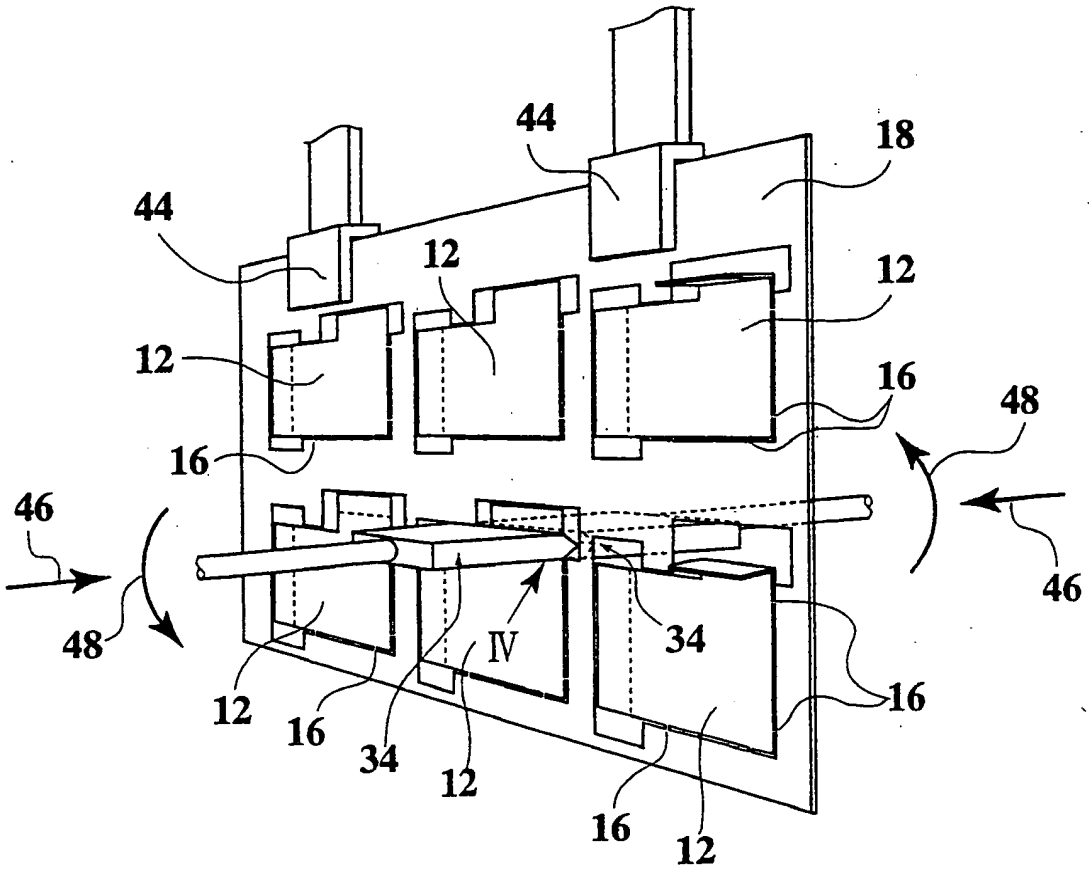


FIG.4

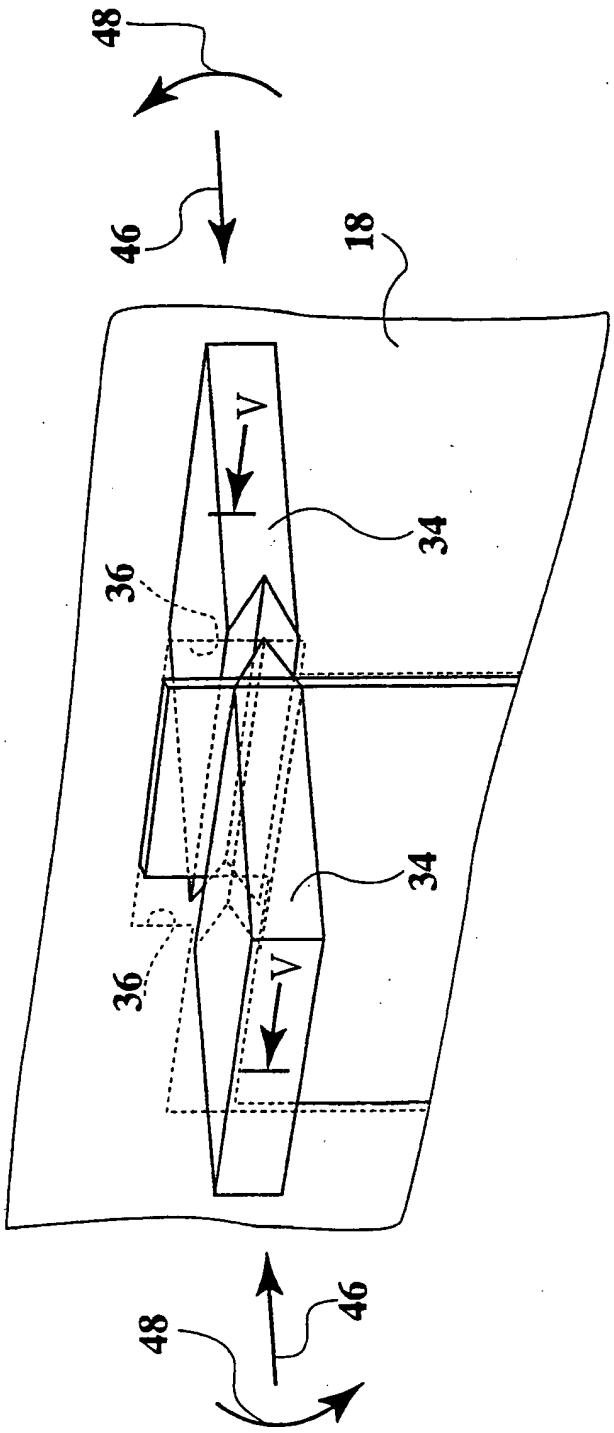


FIG.7

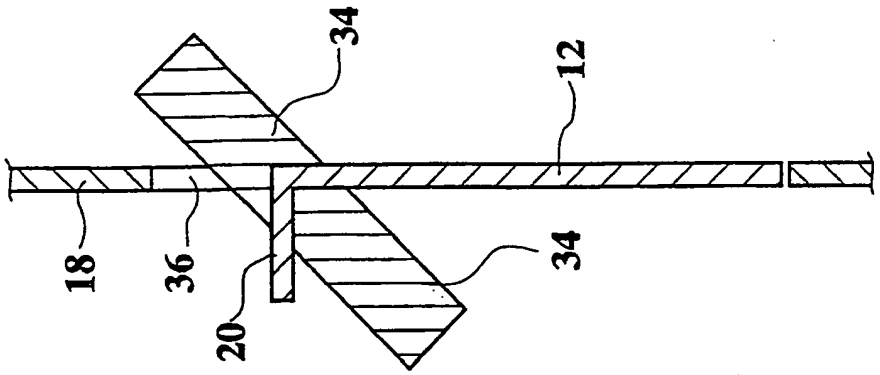


FIG.6

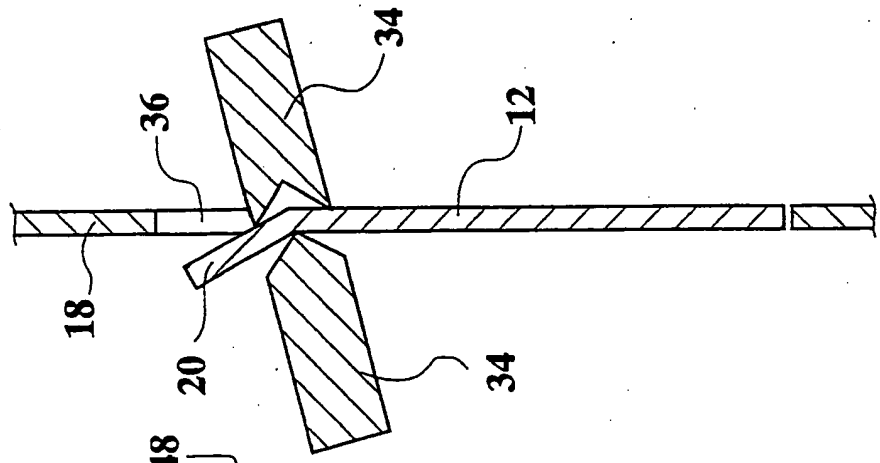


FIG.5

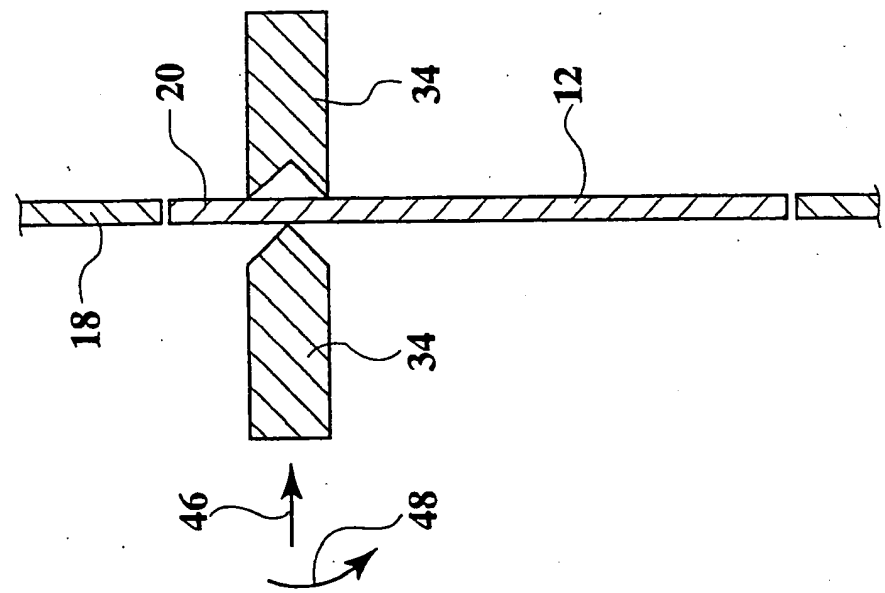


FIG.8

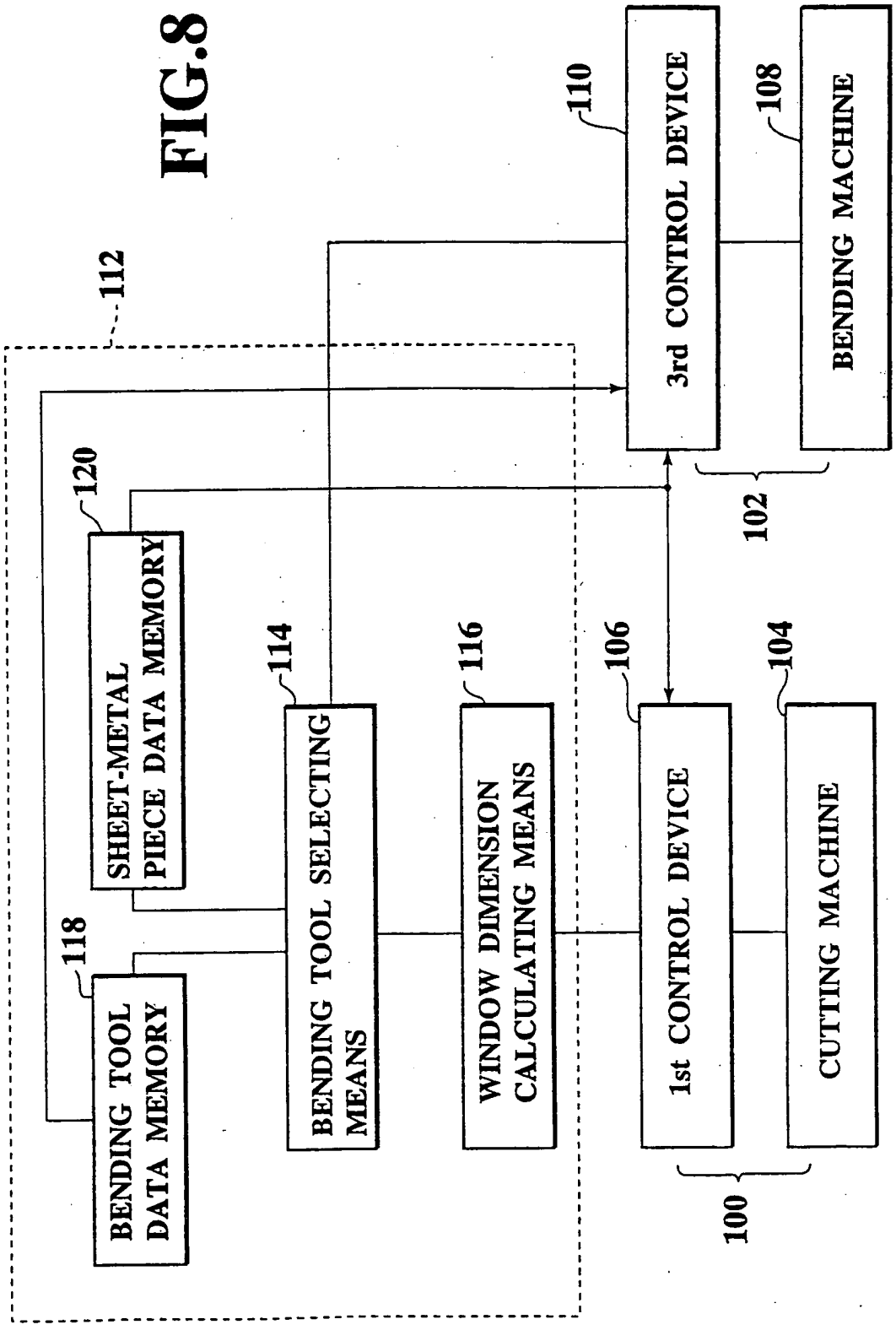
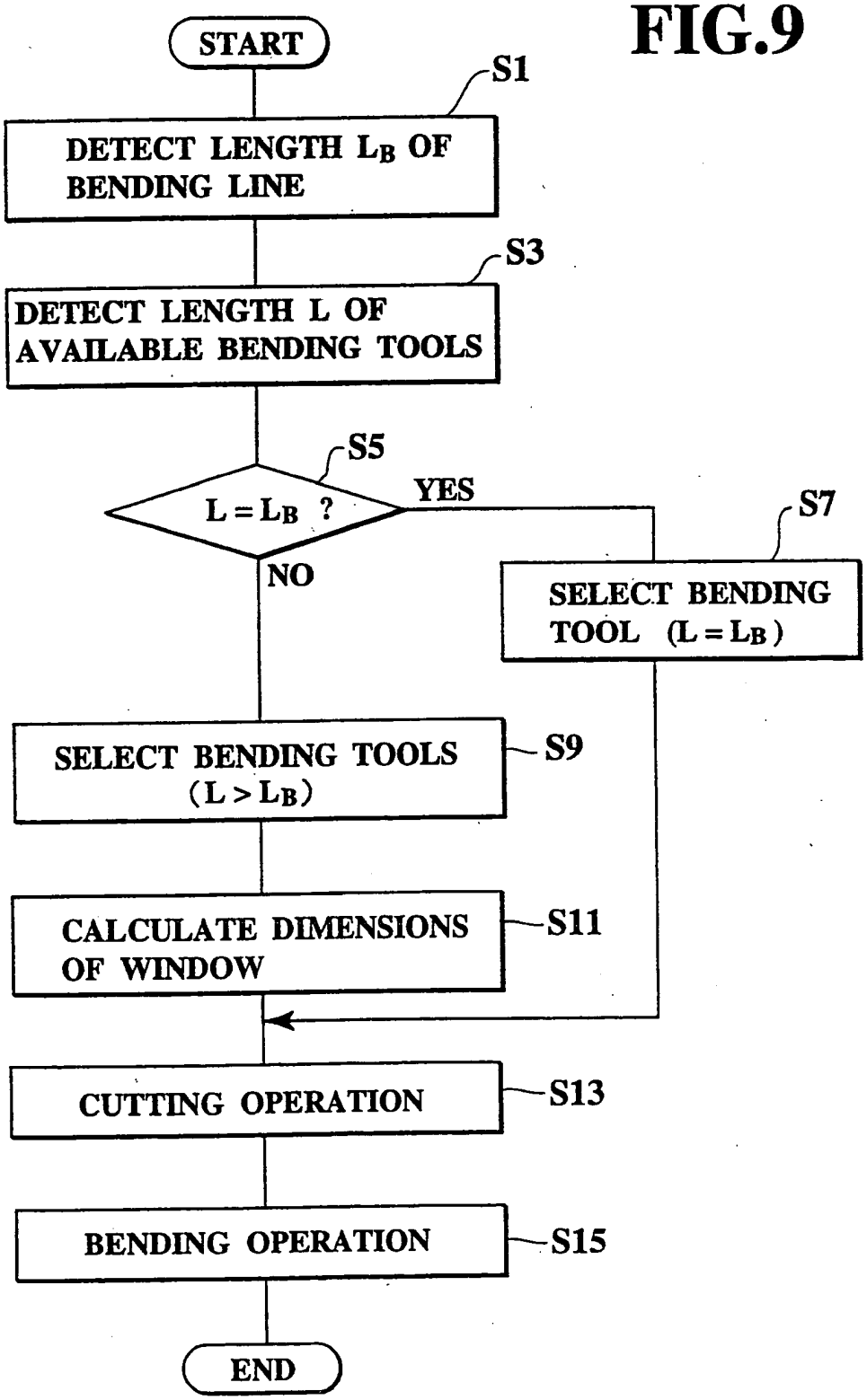

112
110
3rd CONTROL DEVICE
108
BENDING MACHINE
120
SHEET-METAL PIECE DATA MEMORY
102
114
BENDING TOOL SELECTING MEANS
116
WINDOW DIMENSION CALCULATING MEANS
106
104
118
BENDING TOOL DATA MEMORY
1st CONTROL DEVICE
CUTTING MACHINE
100

FIG.9


START
S1
DETECT LENGTH L_B OF BENDING LINE
S3
DETECT LENGTH L OF AVAILABLE BENDING TOOLS
S5
$L = L_B$?
YES
NO
S7
SELECT BENDING TOOL ($L = L_B$)
SELECT BENDING TOOLS ($L > L_B$)
S9
CALCULATE DIMENSIONS OF WINDOW
S11
CUTTING OPERATION
S13
BENDING OPERATION
S15
END

INTERNATIONAL SEARCH REPORT

International Application No
PCT/JP 98/02303

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 B21D35/00 B21D5/00

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	WO 96 24447 A (SAPIM AMADA SPA ;CODATTO ANTONIO (IT)) 15 August 1996 see the whole document	1,3-5, 14,15 9,27
X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 296 (M-846), 10 July 1989 & JP 01 087018 A (ANRITSU CORP), 31 March 1989 see abstract	1,3-5

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
28 July 1998	04/08/1998

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Ris, M

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

ional Application No
PCT/JP 98/02303

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9624447 A	15-08-1996	IT T0950071 A	06-08-1996